

Claims

I Claim:

1. A cracking heater comprising:
  - an enclosed housing comprising a substantially parallel front and back, a pair of substantially parallel sides, which are perpendicular to the front and back and a top and bottom providing a continuous enclosure;
  - at least one heat source;
  - an exhaust duct; and
  - a tube bundle comprising a plurality of continuous horizontal tubes parallel to the pair of sides, the horizontal tubes sequentially linked together by a plurality of tube bends and where at least a portion of the tubes are arranged in a plurality of vertical columns and are horizontally offset from one another, wherein a feedstock is carried through the tubes beginning at a first end of the tube bundle and exiting at a second end of the tube bundle.
2. The cracking heater of claim 1 where at least one heat source is located on each side of the tube bundle between the tube bundle and the respective side.
3. The cracking heater of claim 1 where the tubes have a nominal radius and where the tube bends have a radius of greater than twice the nominal radius.
4. The cracking heater of claim 1 where the feedstock is carried through the tubes beginning at the top of the tube bundle and exiting at the bottom of the tube bundle.
5. The cracking heater of claim 1 where in the portion of the tubes in the plurality of vertical columns, an angle **C** is formed between the center of one

tube as the vertex extending to the two closest tubes in the vertical column adjacent the tube, where the angle **C** is less than 180°.

6. The cracking heater of claim 5 where within each vertical column adjacent tubes are separated by a distance **B**, and within each pair of tubes linked by a tube bend there is distance **E** separating the tubes in the direction of the tube bend, where **E** is greater than or equal to **B**.

7. The cracking heater of claim 5 where for all tubes in the portion of the tubes in the plurality of vertical columns, the angle **C** is less than 180°.

8. The cracking heater of claim 5 where the angle **C** is between about 80° and 40°.

9. The cracking heater of claim 1 where the cracking heater is a coking furnace and where the portion of the tubes in the plurality of vertical columns resides in a radiant heating section of the coking furnace.

- 1    10. A cracking heater comprising:
  - 2        an enclosed housing comprising a substantially parallel front and back, a
  - 3              pair of substantially parallel sides, which are perpendicular to the
  - 4              front and back and a top and bottom providing a continuous
  - 5              enclosure;
  - 6        an exhaust duct;
  - 7        a tube bundle comprising a plurality of continuous horizontal tubes
  - 8              parallel to the pair of sides each with a front end and a back end,
  - 9              the horizontal tubes linked together by a plurality of tube bends at
  - 10             the front end and the back end and arranged in a plurality of
  - 11             vertical columns and horizontally offset from one another, wherein
  - 12             the feedstock is carried through the tubes beginning at a first end
  - 13             of the tube bundle and exiting at a second end of the tube bundle,

14               where in the portion of the tubes in the plurality of vertical  
15               columns, an angle **C** is formed between the center of one tube as  
16               the vertex extending to the two closest tubes in the vertical column  
17               adjacent the tube, where the angle **C** is less than 180°; and  
18               at least one heat source disposed between the tube bundle and each of  
19               the sides.

11. The coking furnace of claim 10 where the tubes have a nominal radius and where the tube bends have a radius of greater than twice the nominal radius.

12. The cracking heater of claim 10 where the feedstock is carried through the tubes beginning at the top of the tube bundle and exiting at the bottom of the tube bundle.

13. The cracking heater of claim 10 where within each vertical column adjacent tubes are separated by a distance **B**, and within each pair of tubes linked by a tube bend there is distance **E** separating the tubes in the direction of the tube bend, where **E** is greater than or equal to **B**.

14. The cracking heater of claim 10 where for all tubes in the portion of the tubes in the plurality of vertical columns, the angle **C** is less than 180°.

15. The cracking heater of claim 10 where the cracking heater is a coking furnace.

16. The cracking heater of claim 10 where the cracking heater is a coking furnace and where the portion of the tubes in the plurality of vertical columns resides in a radiant heating section of the coking furnace.

17. The coking furnace of claim 10 where the portion of the tubes in the plurality of vertical columns extends the entire height of the tube bundle.

1    18. A process for heating a feedstock comprising:  
2        providing a cracking heater having:  
3                an enclosed housing comprising a substantially parallel front and  
4                        back, a pair of substantially parallel sides, which are  
5                        perpendicular to the front and back and a top and bottom  
6                        providing a continuous enclosure,  
7                at least one heat source,  
8                an exhaust duct, and  
9                a tube bundle comprising a plurality of continuous horizontal tubes  
10                        parallel to the pair of sides, the horizontal tubes sequentially  
11                        linked together by a plurality of tube bends and where at  
12                        least a portion of the tubes are arranged in a plurality of  
13                        vertical columns and are horizontally offset from one  
14                        another; and  
15                carrying a feedstock through the tubes beginning at a first end of the tube  
16                        bundle and exiting at a second end of the tube bundle.

19. The process of claim 18 where carrying the feedstock through the tubes  
is accomplished beginning at the top of the tube bundle and exiting at the  
bottom of the tube bundle.

20. The process of claim 18 where in providing the cracking heater, the  
portion of the tubes in the plurality of vertical columns, an angle **C** is formed  
between the center of one tube as the vertex extending to the two closest tubes  
in the vertical column adjacent the tube, where the angle **C** is less than 180°.

21. The process of claim 18 further comprising maintaining the cracking  
heater by cleaning out coke deposited inside the tubes where the maintaining is  
performed at a time interval less frequently than on identical number of identical  
tubes in a cracking heater where all of the tubes are arranged in a single vertical  
column operated at identical temperature.

22. The process of claim 18 where in providing the cracking heater, the tubes have a nominal radius and where the tube bends have a radius of greater than twice the nominal radius.
23. The process of claim 18 where in providing the cracking heater, cracking heater has a height which is less than the height of a cracking heater where all of the tubes are arranged in a single vertical column.
24. The process of claim 18 where in providing the cracking heater, the heat transfer to the feedstock is more efficient as compared with the heat transfer in a cracking heater where all of the tubes are arranged in a single vertical column operated at identical temperature.

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